

(19) World Intellectual Property  
Organization  
International Bureau



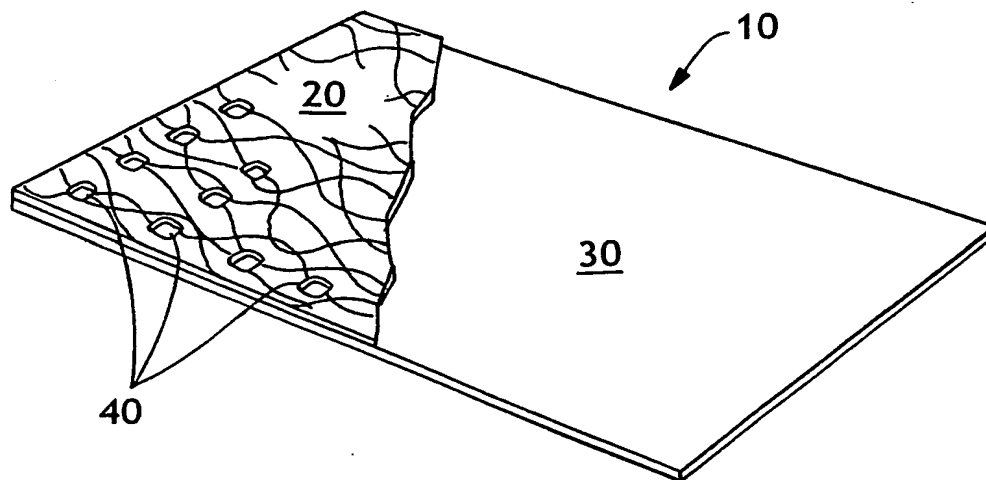
(43) International Publication Date  
23 June 2005 (23.06.2005)

PCT

(10) International Publication Number  
**WO 2005/056656 A1**

- (51) International Patent Classification<sup>7</sup>: C08K 3/00, 3/26, C08J 5/18, A61L 15/26
- (21) International Application Number: PCT/US2004/028310
- (22) International Filing Date: 30 August 2004 (30.08.2004)
- (25) Filing Language: English
- (26) Publication Language: English
- (30) Priority Data:  
10/718,762 21 November 2003 (21.11.2003) US
- (71) Applicant (for all designated States except US): KIMBERLY-CLARK WORLDWIDE, INC. [US/US]; 401 N. Lake Street, Neenah, WI 54956 (US).
- (72) Inventor; and
- (75) Inventor/Applicant (for US only): NING, Xin [US/US]; 205 Rod Court, Alpharetta, GA 30022 (US).
- (74) Agents: CHARLIER, Patricia, A. et al.; Kimberly-Clark Worldwide, INC., 401 N. Lake Street, Neenah, WI 54956 (US).
- (81) Designated States (unless otherwise indicated, for every kind of national protection available): AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BW, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NA, NI, NO, NZ, OM, PG, PH, PL, PT, RO, RU, SC, SD, SE, SG, SK, SL, SY, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, YU, ZA, ZM, ZW.
- (84) Designated States (unless otherwise indicated, for every kind of regional protection available): ARIPO (BW, GH, GM, KE, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HU, IE, IT, LU, MC, NL, PL, PT, RO, SE, SI, SK, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).
- Published:  
— with international search report
- For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

(54) Title: BIODEGRADABLE AND BREATHABLE POLYMER FILM



(57) Abstract: A composition for a film which is both biodegradable and breathable and films prepared from the composition and then stretched are disclosed. The film comprises from about 30% to about 70% by weight of a biodegradable copolyester and from 70% to about 30% by weight of a filler, and the film is stretched in either a monoaxial or biaxial direction to increase void formation and achieve a water vapor transmission rate (WVTR) of at least 800 grams per square meter per 24 hours, and more particularly a WVTR of greater than 1900 grams per square meter per 24 hours. The copolyester is typically a copolyester of aliphatic/aromatic acids and the filler is typically calcium carbonate. The film is suitable for use in disposable breathable products such as personal care products, absorbent products, health care products, bandages and medical fabrics.

BEST AVAILABLE COPY

1A 9595650/5002 OM

## **BIODEGRADABLE AND BREATHABLE POLYMER FILM**

### **FIELD**

The present invention is generally related to biodegradable polymer film compositions and more particularly to breathable biodegradable polymer film compositions.

### **BACKGROUND OF THE INVENTION**

Polymer films are useful in making a variety of disposable articles because they are relatively inexpensive to manufacture, and can be made to be strong, durable, flexible, soft, and a barrier to aqueous liquids such as water. Examples of such disposable products or articles include, but are not limited to, medical and health care products such as surgical drapes, gowns and bandages, protective workwear garments such as coveralls and lab coats, and infant, child and adult personal care absorbent articles such as diapers, training pants, disposable swimwear, incontinence garments and pads, sanitary napkins, wipes and the like. Other uses polymeric film materials include geotextiles. It is often highly desirable for polymeric films used in such product applications to be both liquid impervious and breathable.

It is known that breathable films can be prepared by blending an organic or inorganic incompatible filler with a polyolefin-based resin, which is then melted, film-formed and stretched. These films are mainly used as liquid barriers in disposable personal care products, which are discarded immediately after use. However, the breathable films prepared from polyolefin-based resin cannot be degraded in the natural environment.

There is an increasing demand for the incorporation of more recyclable and/or degradable components in disposable products, and the design of products that can be disposed of by means other than by incorporation into solid waste disposal facilities such as landfills. As such, there is a need for new materials for disposable absorbent products that generally retain their integrity and strength during use, but after such use, are more efficiently disposable. For example, the disposable absorbent product may be easily and efficiently disposed of by composting. Alternatively, the disposable absorbent product may be easily and efficiently disposed of to a liquid sewage system wherein the disposable absorbent product is capable of being degraded.

While it is possible to enhance the breathability and biodegradability of polymer films separately, enhancing the biodegradability of polymer films, without diminishing the breathability of the films, is difficult. For example, biodegradable films derived from copolyesters are known in the art. These films tend to be very flexible and ductile, with high elongation at break. However, due to the extremely ductile nature of these compounds, pore formation in such films is much less pronounced than in comparable polyethylene-based compositions, resulting in a water vapor transmission rate (WVTR) below 400 grams per square meter per 24 hours in the stretched films. This does not compare favorably with breathability values of up to 20,000 WVTR which can be attained in stretched films based on polyethylene compositions. These copolyester films are therefore not suitable for breathable personal care products, but are rather more suited for use as refuse bags, in packaging applications and the like.

Thus, while biodegradable films are known, these films fail to provide the same or substantially similar properties of high permeability to water vapor as the currently used breathable (but not biodegradable) polyethylene films.

Accordingly, there remains a need for a composition which can be used to manufacture a biodegradable film which is also breathable, for use in making disposable or single-use articles of manufacture.

SUMMARY OF THE INVENTION

5           The present invention provides a biodegradable, breathable film and a process for manufacturing a biodegradable, breathable film. The film may comprise from about 30 percent to about 70 percent by weight of a biodegradable copolyester and about 70 percent to about 30 percent by weight of a filler, where the film is stretched in at least a monoaxial direction to achieve a WVTR of at least about 800 grams per square meter per  
10 24 hours. In another embodiment, the film has from about 40 to about 55 weight percent copolyester and from about 60 to about 40 weight percent filler. In still another embodiment, the film may have WVTR of at least about 1900 grams per square meter per 24 hours.

          The biodegradable, breathable film may include copolyesters of aliphatic/aromatic  
15 acids as the copolyester and calcium carbonate as the filler.

          In certain embodiments, the filler may have an average particle size in the range of about 0.1 to about 7 micrometers, and in other embodiments the filler may have an average particle size in the range of about 0.8 to about 2.6 micrometers.

          The biodegradable, breathable film may further include a compatibilizer, and the  
20 compatibilizer may be such as a fatty acid, unsaturated fatty acid, amide thereof, silane coupling agent, alkyl titanate, and so forth.

          The film may be stretched in a monoaxial direction to obtain a stretch ratio of from about less than 1x to about 5x in the machine direction (MD), for example about 200 percent or 250 percent. The film may optionally also be stretched in a biaxial direction so  
25 as to obtain a stretch ratio which is desirably in the range of from less than 1x by 1x to about 3x by 3x in the cross-machine direction (CD).

The process for manufacturing the biodegradable and breathable film includes the steps of melt blending from about 30 percent to about 70 percent by weight of a biodegradable copolyester and from about 70 percent to about 30 percent by weight of a filler to form a resin, film forming the resin to form a film, and then stretching the film in at least a monoaxial direction so as to achieve a water vapor transmission rate of at least 800 grams per square meter per 24 hours. In embodiments, the film may desirably be stretched biaxially.

Further provided are laminates and disposable articles of manufacture comprising the biodegradable, breathable film, such articles as for example medical products, protective garments and personal care absorbent articles.

#### BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is an illustration in partial cut away view of a laminate material comprising the breathable and biodegradable film of the invention.

FIG. 2 is a perspective view of a disposable diaper comprising the breathable and biodegradable film of the invention.

#### DEFINITIONS

As used herein and in the claims, the term "comprising" is inclusive or open-ended and does not exclude additional unrecited elements, compositional components, or method steps. Accordingly, the term "comprising" encompasses the more restrictive terms "consisting essentially of" and "consisting of."

As used herein, "biodegradable" is meant to represent that a material degrades from exposure to air and/or water or from the action of naturally occurring microorganisms such as bacteria, fungi and algae.

As used herein, the term "breathability" refers to the water vapor transmission rate (WVTR) of an area of film. Breathability is measured in grams of water per square meter per day.

As used herein, the term "breathable" refers to a film having a WVTR of at least  
5 800 grams of water per square meter per day.

As used herein, the term "copolymer" generally includes but is not limited to, block, graft, random and alternating copolymers and blends and modifications thereof.

As used herein, the term "filler" is meant to include particulates and other forms of materials which can be added to the film blend and which will not chemically interfere with  
10 or adversely affect the extruded film but which are able to be uniformly dispersed throughout the film. Fillers known in the art include particulate inorganic materials such as for example talc, calcium carbonate, barium carbonate, magnesium carbonate, magnesium sulfate, titanium dioxide, mica, clays, kaolin, diatomaceous earth and the like, and organic particulate materials such as powdered polymers for example TEFLON and  
15 KEVLAR, and wood and other cellulose powders.

As used herein, the term "personal care product" means personal hygiene oriented items such as wipes, diapers, training pants, absorbent underpants, adult incontinence products, feminine hygiene products, and so forth.

20

#### DETAILED DESCRIPTION OF THE INVENTION

The invention provides a composition including a biodegradable copolyester and a filler, the composition being suitable for manufacturing biodegradable films which are also  
25 breathable when stretched in either a monoaxial or biaxial direction. Such films have good mechanical and biodegradable properties compared to films made from the copolyester alone.

Other additives and ingredients may be added to the film layer provided they do not seriously interfere with the ability of the film to be breathable or biodegradable. For example, a compatibilizer such as a fatty acid (e.g. stearic acid, oleic acid or behenic acid), unsaturated fatty acid, amide thereof (e.g. erucamide or oleamide), silane coupling  
5 compound, alkyl titanate, and so forth may be added to enhance the mechanical properties of the film. Colorants, reinforcements and other types of fillers may also be added.

Suitable copolyesters are those having good physical properties and biodegradability. Such copolyesters are disclosed in European Pat. No. EP 1 106 640  
10 and European Pat. No. EP 1 108 737, both to Chung et al., in which copolyesters are prepared by the reaction of (i) 0.1 weight percent to 30 weight percent of an oligomer-like aromatic-aliphatic prepolymer having an average molecular weight of from 300 to 30,000; (ii) 40 weight percent to 71 weight percent of one or more aliphatic or alicyclic dicarboxylic acids or anhydrides; and (iii) 29 weight percent to 60 weight percent of one or more  
15 aliphatic or alicyclic glycerols. Specific examples of suitable aliphatic/aromatic copolyesters are ENPOL® G8060 and IRE® 8000 from Ire Chemical Ltd of Seoul, South Korea, and EASTAR® from Eastman Chemical of Kingsport, Tennessee, USA.

Generally the filler will be an inorganic filler in particulate form and usually will have somewhat of a spherical shape with an average particle size in the range of about 0.1 to  
20 about 7 micrometers, and more particularly in the range of about 0.5 to about 2.6 micrometers. Examples of inorganic fillers include calcium carbonate, magnesium carbonate, barium carbonate, magnesium sulfate, barium sulfate, calcium sulfate, zinc oxide, magnesium oxide, calcium oxide, titanium oxide, barium oxide, aluminum oxide, aluminum hydroxide, hydroxyapatite, silica, mica, talc, kaolin, clay, glass powder,  
25 asbestos powder, zeolite and acid clay. Particularly desirable inorganic fillers are calcium carbonate, magnesium oxide, barium sulfate, silica and acid clay. Calcium carbonate can

be obtained from English China Clay (trading as Imerys) of Roswell, Georgia, USA, or from Omya of Florence, Vermont, USA.

Generally, on a dry weight basis, based upon the total weight of the film, the composition will include from about 30 to about 70 weight percent copolyester and from about 70 to about 30 weight percent filler. More desirably, the composition will include from about 40 to about 55 weight percent copolyester and from about 60 to about 40 weight percent filler. For example, the copolyester and filler may be present in a ratio of 50:50 by weight.

In order to provide uniform breathability as reflected by the water vapor transmission rate (WVTR) of the film, the filler should be substantially uniformly dispersed throughout the composition and, consequently, throughout the film itself.

The copolyester and filler may be mixed in appropriate proportions given the ranges outlined above and then compounded and extruded into a film layer using any one of a variety of film-producing processes known to those of ordinary skill in the art, including casting and blowing. The composition may alternatively be pelletized prior to the film-forming step, instead of the film being obtained directly from the extruder. The extrusion temperature may desirably be in the range of from about 180 degrees Celsius to about 270 degrees Celsius, and more desirably in the range of from about 200 degrees Celsius to about 250 degrees Celsius, for example, about 220 degrees Celsius.

The film may then be stretched in a monoaxial direction to obtain a stretch ratio of from about less than 1x to about 5x in the machine direction (MD), for example about 200 percent or 250 percent, as detailed more fully in U.S. Pat. Nos. 5,695,868 and 5,855,999 both to McCormack, incorporated herein by reference in their entireties, in order to make it porous. The film may optionally also be stretched in a biaxial direction (i.e. in both longitudinal and lateral directions) so as to obtain a stretch ratio which is desirably in the range of from less than 1x by 1x to about 3x by 3x in the cross-machinedirection (CD), for example, about 64 percent by 64 percent. The stretching temperature may be in the



range of from 20 to about 100 degrees Celsius, for example, 22, 30 or 70 degrees Celsius.

By stretching the film, void formation in the film is enhanced and hence the film is made more porous and breathable. Biaxial stretching of the film produces even greater void formation and hence enhanced breathability of the film.

For purposes of the present invention, a film is "breathable" if it has a WVTR of at least 800 grams per square meter per 24 hours as calculated using the MOCON® test method, which is described in more detail below. The WVTR of the film of this invention is within the range from about 800 to about 15,000 grams per square meter per 24 hours, is more desirably within the range of 1,900 to 15,000 grams per square meter per 24 hours, and is even more desirably at least about 2,500 grams per square meter per 24 hours.

Generally, once the film is formed, it will have a weight per unit area of less than about 100 grams per square meter, and after stretching and thinning its weight per unit area or basis weight will desirably be less than about 35 grams per square meter. In some embodiments, the basis weight will desirably be less than about 25 grams per square meter, and more desirably less than about 20 grams per square meter, and still more desirably less than about 17 grams per square meter.

The thickness of the film may differ depending upon its uses and is generally in the range of from about 10 to about 300 micrometers.

The film has an elongation at break of at least about 10 percent and, more desirably at least about 200 percent.

As a result, while not meaning to be limited to the specific uses as herein specified, the film of the present invention has particular use as a backing material for personal care items, absorbent products, health care products, medical fabrics and the like.

## MOCON® Water Vapor Transmission Rate Test:

A suitable technique for determining the water vapor transmission rate (WVTR) value of a material is the test procedure standardized by INDA (Association of the Nonwoven Fabrics Industry), number IST-70.4-99, entitled "STANDARD TEST METHOD FOR WATER VAPOR TRANSMISSION RATE THROUGH NONWOVEN AND PLASTIC FILM USING A GUARD FILM AND VAPOR PRESSURE SENSOR" which is incorporated by reference herein. The INDA procedure provides for the determination of WVTR, the permeance of the film to water vapor and, for homogeneous materials, water vapor permeability coefficient.

The INDA test method is well known and will not be set forth in detail herein. However, the test procedure is summarized as follows. A dry chamber is separated from a wet chamber of known temperature and humidity by a permanent guard film and the sample material to be tested. The purpose of the guard film is to define a definite air gap and to quiet or still the air in the air gap while the air gap is characterized. The dry chamber, guard film, and the wet chamber make up a diffusion cell in which the test film is sealed. The sample holder is known as the PERMATRAN-W® model 100K manufactured by Modern Controls, Inc (MOCON®) of Minneapolis, Minnesota, USA. A first test is made of the WVTR of the guard film and air gap between an evaporator assembly that generates 100 percent relative humidity. Water vapor diffuses through the air gap and the guard film and then mixes with a dry gas flow which is proportional to water vapor concentration. The electrical signal is routed to a computer for processing. The computer calculates the transmission rate of the air gap and guard film and stores the value for further use.

The transmission rate of the guard film and air gap is stored in the computer as CalC. The sample material is then sealed in the test cell. Again, water vapor diffuses through the air gap to the guard film and the test material and then mixes with a dry gas flow that sweeps the test material. Also, again, this mixture is carried to the vapor sensor.

The computer then calculates the transmission rate of the combination of the air gap, the guard film, and the test material.

This information is then used to calculate the transmission rate at which moisture is transmitted through the test material according to the equation:

5

$$TR_{\text{test material}}^{-1} = TR_{\text{test material, guardfilm, airgap}}^{-1} - TR_{\text{guardfilm, airgap}}^{-1}$$

The calculation of the WVTR uses the formula:

10

$$WVTR = F_{\rho_{\text{sat}}(T) RH} / A_{\rho_{\text{sat}}(T) (1-RH)}$$

where:

15

$F$  = the flow of water vapor in cc/min,

$\rho_{\text{sat}}(T)$  = the density of water in saturated air at temperature  $T$ ,

$RH$  = the relative humidity at specified locations in the cell,

$A$  = the cross sectional area of the cell, and

$\rho_{\text{sat}}(T)$  = the saturation vapor pressure of water vapor at temperature  $T$ .

20

The invention will now be described in more detail by way of the following non-limiting examples, which are designed to illustrate particular aspects of the invention and teach one of ordinary skill in the art how to carry out the invention.

25

## EXAMPLES

### Example 1

A biodegradable copolyester polymer resin, ENPOL® G8060 was obtained from Ire Chemical Ltd of South Korea. ENPOL® G8060 is a fully biodegradable

aromatic/aliphatic copolyester having a melting point of 127 degrees Celsius, a melt index of 1.4 – 5 g/10 min at 190 degrees Celsius and 2160 g load.

Two biodegradable films (A and B, respectively) were prepared and evaluated to determine the water vapor transmission rate (WVTR) of each film. Film A was prepared  
5 using calcium carbonate obtained from English China Clay, and film B was prepared using calcium carbonate obtained from Omya (OMYACARB® 2SST).

The copolyester was compounded with the calcium carbonate in a 50:50 weight percent ratio, using a twin screw extruder. The composition was then melt extruded into films of about 20 micrometer thickness. The extrusion temperature was in the range of  
10 from about 180 to about 270 degrees Celsius, and more desirably in the range of from about 200 to about 250 degrees Celsius.

(a) First samples of each of films A and B (samples A1 and B1, respectively) were placed into a conventional machine direction orientation unit (MDO), such as that manufactured by the Marshall and Williams Company, where they were stretched in the  
15 machine direction (MD) as described in U.S. Pat. No. 5,695,868 and U.S. Pat. No. 5,855,999, both to McCormack, so as to obtain a stretch percentage of 250 percent. The stretching was performed in an oven at a temperature of 70 degrees Celsius. After stretching, heat setting was carried out in order to enhance form stability of the pores.

The stretch ratio was defined as:

20 
$$\text{Stretch percent} = (\text{final film length} - \text{original length}) / \text{original length} \times 100$$

(b) Second samples of each of films A and B (samples A2 and B2, respectively) were placed into the same MDO unit and were stretched in the MD direction so as to obtain a stretch percentage of 200 percent at 30 degrees Celsius.

The WVTR of the films was measured in accordance with the MOCON® method  
25 described above. The results are shown in Table 1.

TABLE 1. Monoaxial stretching of film samples

Film Sample	Stretch Ratio	Stretch Temperature	WVTR
A1	250 percent	70 degrees Celsius	1900
A2	200 percent	30 degrees Celsius	2232
B1	250 percent	70 degrees Celsius	2553
B2	200 percent	30 degrees Celsius	2477

5 Example 2

Samples from each of films A and B prepared in Example 1 (samples A3 and B3 respectively) were subjected to biaxial stretching. The films were fed through a set of intermeshing groove rolls at ambient room temperature (about 22 degrees Celsius). The engagement of the rolls created cross-machine directional (CD) extension, the extent of which was measured by the length gain in CD direction. The stretched films were then rotated approximately 90 degrees and again fed through the groove rolls to perform a second direction extension or stretch such that the films had been biaxially extended or stretched. After stretching, heat setting was carried out in order to enhance form stability of the pores.

15 The stretch ratio was defined by percentage length gain in both directions.

The WVTR measurements were again determined according to the MOCON® method described above, and the results are shown in Table 2.

TABLE 2. Biaxial stretching of film samples.

Film Sample	Stretch Ratio	Stretch Temperature	WVTR
A3	64 percent by 64 percent	22 degrees Celsius	2792
B3	64 percent by 64 percent	22 degrees Celsius	3501

The examples above indicate that a biodegradable film can be produced having a good WVTR value and hence good breathability. Further, the breathability of the films is markedly enhanced when the films are biaxially stretched. Such breathable and biodegradable films are highly useful for use in single-use or disposable articles and products where a fluid impervious barrier is required but the barrier is also desirably breathable. Examples of such products include, but are not limited to, medical and health care products such as surgical drapes, gowns and bandages, protective workwear garments such as coveralls and lab coats, and infant, child and adult personal care absorbent articles such as diapers, training pants, disposable swimwear, incontinence garments and pads, sanitary napkins, wipes and the like. Other uses for such breathable and biodegradable polymeric film materials may include geotextiles. While not described in detail herein, various additional potential processing and/or finishing steps known in the art such as aperturing, slitting, further stretching, treating, or lamination of the breathable and biodegradable polymeric film materials with other films or with nonwoven web layers, may be performed without departing from the spirit and scope of the invention.

Examples of lamination of the breathable and biodegradable polymeric film materials with other films or nonwoven layers include laminate materials having two or more layers, such as the exemplary bi-layer laminate material shown in FIG. 1.

Nonwoven fabrics or webs have been formed from many processes such as for example, meltblowing processes, spunbonding processes, airlaying processes, and carded web processes. FIG. 1 demonstrates a laminate material which is a laminate of the breathable and biodegradable polymeric film with a nonwoven web layer such as, for example, a spunbond web layer bonded to the film. Spunbond nonwoven webs are well known in the art and will not be described herein in detail. Briefly, spunbond refers to a nonwoven fiber or filament material of small diameter filaments that are formed by extruding molten thermoplastic polymer as filaments from a plurality of capillaries of a spinneret. The extruded filaments are cooled while being drawn by an eductive or other well known

drawing mechanism. The drawn filaments are deposited or laid onto a forming surface in a generally random manner to form a loosely entangled filament web, and then the laid filament web is subjected to a bonding process to impart physical integrity and dimensional stability. The production of spunbond fabrics is disclosed, for example, in U.S. Pat. Nos. 4,340,563 to Appel et al., 3,692,618 to Dorschner et al., and 3,802,817 to Matsuki et al., all of which are incorporated herein by reference in their entireties.

Typically, spunbond fibers or filaments have a weight-per-unit-length in excess of about 1 denier and up to about 6 denier or higher, although both finer and heavier spunbond filaments can be produced. In terms of filament diameter, spunbond filaments often have an average diameter of larger than 7 microns, and more particularly between about 10 and about 25 microns, and up to about 30 microns or more.

FIG. 1 is a schematic only, simply illustrative of one of the types of laminates intended. Generally, such multi-layer nonwoven-film laminate materials have a basis weight of from about 3 to about 400 grams per square meter, or more particularly from about 15 grams per square meter to about 150 grams per square meter. As shown in FIG. 1, the bi-layer laminate material is generally designated 10 and comprises breathable and biodegradable polymeric film layer 30 to which is attached a nonwoven web layer 20. As is known to one skilled in the art, such laminates may be laminate bonded by, for example, adhesive bonding, ultrasonic bonding, or thermal bonding such as thermal point or "spot" bonding. Additionally shown in FIG. 1 are bond points 40 such as may be made by a thermal spot bonding process, which bond or mate the two materials of the laminate together at spaced apart locations in a pattern of spots. Adhesive bonding as is known in the art may be particularly advantageous where the component layers of the laminate to be bonded together do not thermally bond well together, as where the components have disparate melting points or softening temperatures. In addition, it should be noted that the breathable and biodegradable films may also be laminated as part of a tri-laminate material such as a nonwoven/film/nonwoven laminate material. Such a tri-laminate

material may be particularly desirable in applications, such as for example in disposable medical fabrics, where it is useful to have a more cloth-like layer on both sides of the breathable barrier film layer.

As was mentioned, the breathable and biodegradable polymeric film materials of the invention are also highly suitable for use in personal care absorbent articles. Turning to FIG. 2 there is shown an exemplary personal care article such as the diaper 60. Diaper 60, as is typical for most personal care absorbent articles, includes a liquid permeable body side liner 64, i.e., a body-facing or inner side, and a liquid impermeable outer cover 62, i.e., a non-body facing or outer side. Various woven or nonwoven fabrics can be used for body side liner 64 such as a spunbond nonwoven web of polyolefin fibers, or a bonded carded web of natural and/or synthetic fibers. Liner 64 may also beneficially be a spunbonded web or carded web material comprising the multicomponent fibers of invention. Outer cover 62 is formed of a thin liquid barrier material such as for example the breathable and biodegradable polymeric film materials of the invention. Such a polymer film material outer cover may be embossed and/or matte finished to provide a more aesthetically pleasing appearance, or may be a laminate formed of the breathable and biodegradable film and a woven or nonwoven web material, such as was described above, to provide a more aesthetically pleasing feel and sound or more "cloth-like" characteristics.

Disposed between liner 64 and outer cover 62 is an absorbent core 66 formed, for example, of a blend of hydrophilic cellulosic wood pulp fluff fibers and highly absorbent gelling particles (e.g., superabsorbent material). Absorbent core 66 may further comprise thermoplastic binder fibers as are known in the art. Diaper 60 may further include optional containment flaps 72 made from or attached to body side liner 64. Suitable constructions and arrangements for such containment flaps are described, for example, in U.S. Pat. No. 4,704,116 to Enloe, incorporated herein by reference in its entirety. Still further, the



diaper 60 can optionally include additional elements known to those skilled in the art, including but not limited to, elasticized leg cuffs, elastic waist band, and so forth.

To secure the diaper 60 about the wearer, the diaper will have some type of fastening means attached thereto. As shown in FIG. 2, the fastening means is a hook and loop fastening system including hook elements 74 attached to the inner and/or outer surface of outer cover 62 in the back waistband region of diaper 60 and one or more loop elements or patches 76 attached to the outer surface of outer cover 62 in the front waistband region of diaper 60. The loop material for loop patch 76 can be a woven, nonwoven or knitted loop material and may be secured to outer cover 62 of diaper 60 by known attachment means, including but not limited to adhesives, thermal bonding, ultrasonic bonding, or a combination of such means. As an alternative embodiment, a nonwoven loop material may cover all of, or substantially all of, the outer surface of outer cover 62.

While various patents and other reference materials have been incorporated herein by reference, to the extent there is any inconsistency between incorporated material and that of the written specification, the written specification shall control. In addition, while the invention has been described in detail with respect to specific embodiments thereof, it will be apparent to those skilled in the art that various alterations, modifications and other changes may be made to the invention without departing from the spirit and scope of the present invention. It is therefore intended that the claims cover or encompass all such modifications, alterations and/or changes.

CLAIMS:

1. A biodegradable, breathable film comprising:  
about 30 percent to about 70 percent by weight of a biodegradable copolyester; and  
5 about 70 percent to about 30 percent by weight of a filler;  
wherein the film is stretched in at least a monoaxial direction to achieve a WVTR of  
at least about 800 grams per square meter per 24 hours.
2. The film of Claim 1, which is stretched in a monoaxial direction so as to obtain a  
10 machine direction stretch ratio of from about 2x to about 5x.
3. The film of Claim 1, which is stretched biaxially.
4. The film of Claim 3, which is stretched so as to obtain a cross-machine direction  
15 stretch ratio of from about 1x by 1x to about 3x by 3x.
5. The film of Claim 1, wherein the biodegradable copolyester comprises a copolyester  
of aliphatic/aromatic acids.
- 20 6. The film of Claim 1, wherein the filler is calcium carbonate.
7. The film of Claim 1, wherein the filler is a particulate material having an average  
particle size in the range of from about 0.1 to about 7 micrometers.
- 25 8. The film of Claim 1, wherein the filler is a particulate material having an average  
particle size in the range of from about 0.8 to about 2.6 micrometers.

9. The film of Claim 1, which further comprises a compatibilizer.

10. The film of Claim 9, wherein the compatibilizer is selected from the group consisting of fatty acids, fatty acid amides, silane compounds and alkyl titanates.

5

11. The film of Claim 9, wherein the compatibilizer comprises from about 0.02 weight percent to about 2 weight percent of the film.

12. The film of Claim 1, which comprises from about 40 percent to about 55 percent by weight of the biodegradable copolyester and from about 45 percent to about 60 percent by weight of the filler.

10

13. The film of Claim 1, which has a water vapor transmission rate of greater than about 1900 grams per square meter per 24 hours.

15

14. The film of Claim 12, further comprising at least one additional layer bonded thereto.

15. A disposable article of manufacture comprising a film according to Claim 1.

20 16. The disposable article of Claim 15, which is selected from the group consisting of medical products, protective garments and personal care absorbent articles.

25

17. A process for manufacturing a biodegradable and breathable film, comprising the steps of:

melt blending from about 30 percent to about 70 percent by weight of a biodegradable copolyester and from about 70 percent to about 30 percent by weight of a  
5 filler to form a resin;

film forming the resin to form a film; and

stretching the film in at least a monoaxial direction so as to achieve a water vapor transmission rate of at least 800 grams per square meter per 24 hours.

10 18. The process of Claim 17, further including the step of stretching the film in a biaxial direction.

19. The process of Claim 17 wherein the inorganic filler is calcium carbonate.

15 20. The process of Claim 17 wherein the biodegradable copolyester comprises a copolyester of aliphatic/aromatic acids.

1/1

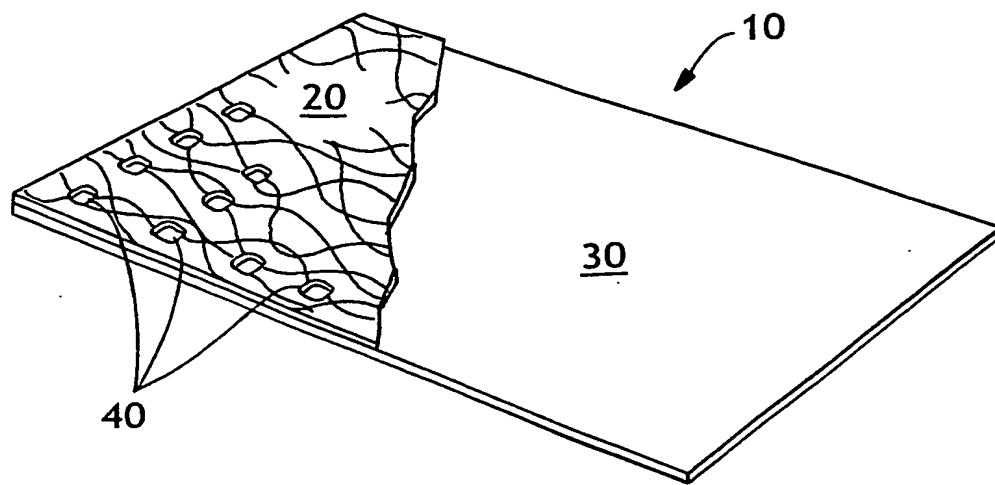


FIG. 1

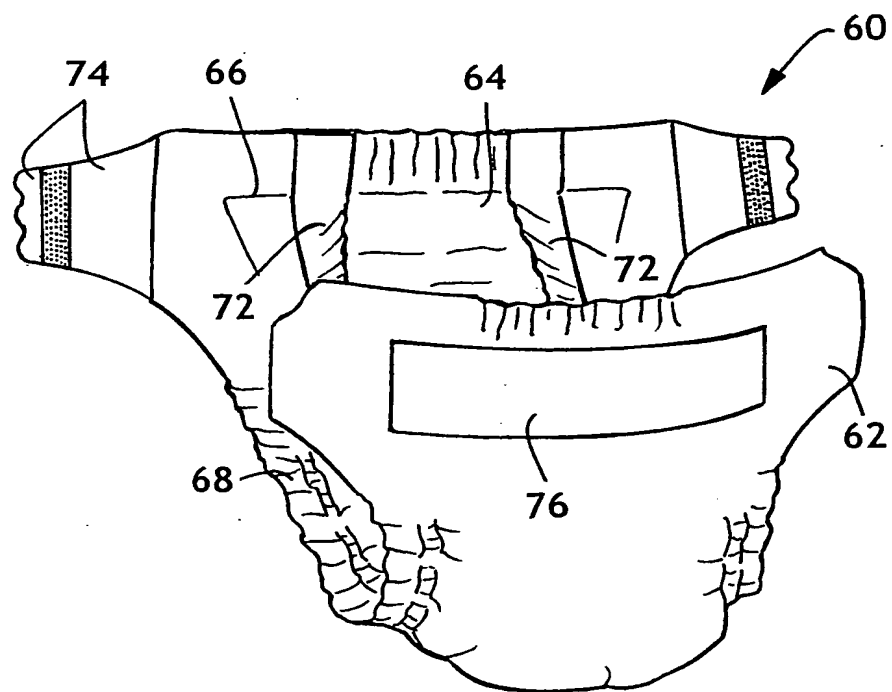


FIG. 2

# INTERNATIONAL SEARCH REPORT

International Application No  
PCT/US2004/028310

## A. CLASSIFICATION OF SUBJECT MATTER

IPC 7 C08K3/00 C08K3/26 C08J5/18 A61L15/26

According to International Patent Classification (IPC) or to both national classification and IPC

## B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 7 C08K C08L A61L C08J

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal, WPI Data, PAJ

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 5 998 505 A (BRINK MARY HEATHER) 7 December 1999 (1999-12-07) column 1, line 57 - column 2, line 43 column 2, line 51 - line 67 column 3, line 2 - line 8 column 3, line 34 - line 55 column 5, line 19 - line 61 column 8, line 24 - line 32 claims; examples 3,4,8-20,24,25	1-20
X	US 2002/098341 A1 (SCHIFFER DANIEL K ET AL) 25 July 2002 (2002-07-25) page 1, paragraphs 7,8 page 2, paragraphs 17,18 page 2, paragraph 24 - page 3, paragraph 27 page 3, paragraphs 33,34 page 4, paragraph 44; claims	1-20
	-/-	

☒ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

### \* Special categories of cited documents :

- \*A\* document defining the general state of the art which is not considered to be of particular relevance
- \*E\* earlier document but published on or after the international filing date
- \*L\* document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
- \*O\* document referring to an oral disclosure, use, exhibition or other means
- \*P\* document published prior to the international filing date but later than the priority date claimed

- \*T\* later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
- \*X\* document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
- \*Y\* document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.
- \* & \* document member of the same patent family

Date of the actual completion of the international search

7 December 2004

Date of mailing of the international search report

21/12/2004

Name and mailing address of the ISA

European Patent Office, P.B. 5818 Patentlaan 2  
NL - 2280 HV Rijswijk  
Tel. (+31-70) 340-2040, Tx. 31 651 epo nl,  
Fax: (+31-70) 340-3016

Authorized officer

Masson, P

# INTERNATIONAL SEARCH REPORT

International Application No  
PCT/US2004/028310

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT		
Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	<p>EP 0 510 998 A (MITSUI TOATSU CHEMICALS) 28 October 1992 (1992-10-28) page 2, line 33 - line 45 page 4, line 1 - line 12 page 4, line 49 - page 5, line 14 page 5, line 27 - line 30; claims; tables 3,4</p> <p style="text-align: center;">-----</p>	1-4, 6-20
X	<p>DATABASE WPI Section Ch, Week 199338 Derwent Publications Ltd., London, GB; Class A23, AN 1993-297841 XP002309304 -&amp; JP 05 209073 A (TOKUYAMA SODA KK) 20 August 1993 (1993-08-20) abstract &amp; JP 05 209073 A (TOKUYAMA SODA KK) 20 August 1993 (1993-08-20) paragraphs '0008!', '0009!', '0011!' - '0015! paragraphs '0019!', '0023!', '0025!', '0029!' - '0035!; claims; examples 6,7</p> <p style="text-align: center;">-----</p>	1-4, 6-20
A	<p>DATABASE WPI Section Ch, Week 199704 Derwent Publications Ltd., London, GB; Class A23, AN 1997-038059 XP002309305 -&amp; JP 08 295748 A (DAICEL CHEM IND LTD) 12 November 1996 (1996-11-12) abstract</p> <p style="text-align: center;">-----</p>	1-20
X	<p>DATABASE WPI Section Ch, Week 199804 Derwent Publications Ltd., London, GB; Class A23, AN 1998-037109 XP002309306 -&amp; JP 09 291163 A (MITSUBISHI CHEM CORP) 11 November 1997 (1997-11-11) abstract &amp; JP 09 291163 A (MITSUBISHI CHEM CORP) 11 November 1997 (1997-11-11) paragraphs '0005!', '0006! paragraphs '0020!' - '0024!', '0029!' - '0031!; examples</p> <p style="text-align: center;">-----</p>	1-20
X	<p>US 5 292 783 A (GEDON STEVEN C ET AL) 8 March 1994 (1994-03-08) column 1, line 11 - line 22 column 5, line 30 - line 52; claims; examples</p> <p style="text-align: center;">-----</p> <p style="text-align: center;">-/--</p>	1-20

# INTERNATIONAL SEARCH REPORT

International Application No

PCT/US2004/028310

## C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	<p>           DATABASE WPI            Section Ch, Week 199804            Derwent Publications Ltd., London, GB;            Class A23, AN 1998-037110            XP002309307            -&amp; JP 09 291164 A (MITSUBISHI CHEM CORP)            11 November 1997 (1997-11-11)            abstract            -----         </p>	. 1-20



# INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No

PCT/US2004/028310

Patent document cited in search report		Publication date	Patent family member(s)	Publication date
US 5998505	A	07-12-1999	BR 9713449 A	28-03-2000
			CA 2272316 A1	04-06-1998
			CN 1245509 A	23-02-2000
			EP 0941278 A1	15-09-1999
			WO 9823673 A1	04-06-1998
US 2002098341	A1	25-07-2002	AU 2700702 A	18-06-2002
			EP 1341839 A1	10-09-2003
			JP 2004532901 T	28-10-2004
			MX PA03004758 A	19-08-2003
			WO 0246277 A1	13-06-2002
EP 0510998	A	28-10-1992	DE 69213304 D1	10-10-1996
			DE 69213304 T2	06-03-1997
			EP 0510998 A2	28-10-1992
			JP 3167411 B2	21-05-2001
			JP 5247245 A	24-09-1993
			US 5405887 A	11-04-1995
			US 5340646 A	23-08-1994
JP 5209073	A	20-08-1993	JP 3135154 B2	13-02-2001
JP 8295748	A	12-11-1996	NONE	
JP 9291163	A	11-11-1997	JP 3512970 B2	31-03-2004
US 5292783	A	08-03-1994	AT 150058 T	15-03-1997
			AT 199383 T	15-03-2001
			AU 696544 B2	10-09-1998
			AU 4557496 A	06-06-1996
			AU 664831 B2	07-12-1995
			AU 9105091 A	25-06-1992
			BR 9107138 A	05-04-1994
			CA 2095536 A1	31-05-1992
			CN 1324891 A ,B	05-12-2001
			CN 1062740 A	15-07-1992
			CN 1183426 A	03-06-1998
			CN 1183423 A ,B	03-06-1998
			CN 1183433 A ,B	03-06-1998
			CN 1183427 A	03-06-1998
			CN 1183428 A	03-06-1998
			CN 1183429 A	03-06-1998
			DE 69125170 D1	17-04-1997
			DE 69132548 D1	05-04-2001
			DE 69132548 T2	28-06-2001
			EP 0559785 A1	15-09-1993
			EP 0736557 A1	09-10-1996
			EP 0950678 A1	20-10-1999
			FI 932450 A	28-05-1993
			FI 20000496 A	03-03-2000
			IE 914155 A1	03-06-1992
			JP 6504558 T	26-05-1994
			JP 3362040 B2	07-01-2003
			JP 3393124 B2	07-04-2003
			JP 2001354802 A	25-12-2001
			JP 3530178 B2	24-05-2004
			JP 2003128768 A	08-05-2003
			JP 2003221464 A	05-08-2003

# INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No

PCT/US2004/028310

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 5292783	A	JP 2004084156 A	18-03-2004
		KR 220443 B1	15-09-1999
		KR 245905 B1	15-03-2000
		KR 233885 B1	15-03-2000
		KR 245906 B1	15-03-2000
		MX 9102312 A1	31-01-1994
		NO 931920 A	16-07-1993
		NZ 240799 A	26-01-1994
		SG 47853 A1	17-04-1998
		WO 9209654 A2	11-06-1992
		US 6342304 B1	29-01-2002
		US 5446079 A	29-08-1995
		US 5599858 A	04-02-1997
		US 5580911 A	03-12-1996
		US 5559171 A	24-09-1996
		US 6495656 B1	17-12-2002
		US 5900322 A	04-05-1999
JP 9291164	A	11-11-1997	JP 3572162 B2
			29-09-2004

**This Page is Inserted by IFW Indexing and Scanning  
Operations and is not part of the Official Record**

**BEST AVAILABLE IMAGES**

Defective images within this document are accurate representations of the original documents submitted by the applicant.

Defects in the images include but are not limited to the items checked:

- ☒ **BLACK BORDERS**
- ☐ **IMAGE CUT OFF AT TOP, BOTTOM OR SIDES**
- ☐ **FADED TEXT OR DRAWING**
- ☐ **BLURRED OR ILLEGIBLE TEXT OR DRAWING**
- ☐ **SKEWED/SLANTED IMAGES**
- ☐ **COLOR OR BLACK AND WHITE PHOTOGRAPHS**
- ☐ **GRAY SCALE DOCUMENTS**
- ☐ **LINES OR MARKS ON ORIGINAL DOCUMENT**
- ☐ **REFERENCE(S) OR EXHIBIT(S) SUBMITTED ARE POOR QUALITY**
- ☐ **OTHER:** \_\_\_\_\_

**IMAGES ARE BEST AVAILABLE COPY.**

**As rescanning these documents will not correct the image problems checked, please do not report these problems to the IFW Image Problem Mailbox.**

**THIS PAGE BLANK (USPTO)**